4. SUMMARY OF SOUTH PACIFIC AND SOUTH INDIAN OCEAN TROPICAL CYCLONES

4.1 GENERAL

On 1 October 1980, JTWC's area of responsibility (AOR) was expanded to include the Southern Hemisphere from 180° east longitude westward to the coast of Africa. Details on Southern Hemisphere tropical cyclones and JTWC warnings from July 1980 through June 1982 are contained in Diercks et al. (1982) and from July 1982 through June 1984, in Wirfel and Sandgathe (1986). Information on Southern Hemisphere tropical cyclones after June 1984 can be found in the applicable Annual Tropical Cyclone Report.

The Naval Western Oceanography Center (NWOC) Pearl Harbor, HI issues warnings on tropical cyclones in the South Pacific east of 180° east longitude.

In accordance with CINCPACINST 3140.1U (series), Southern Hemisphere tropical cyclones are numbered sequentially from 1 July through 30 June. This convention is established to encompass the Southern Hemisphere tropical cyclone season, which primarily occurs from January through April. There are two ocean basins for warning purposes - the South Indian (west of 135° east longitude) and the South Pacific (east of 135° east longitude) - which are identified by appending the suffixes "S" and "P" respectively to the tropical cyclone number.

Intensity estimates for Southern Hemisphere tropical cyclones are derived from the interpretation of satellite imagery using the Dvorak technique (Dvorak, 1984) and in rare instances from surface observations. The Dvorak technique relates specific cloud signatures to maximum sustained one-minute average wind speeds. The conversion from maximum sustained winds to minimum sea-level pressure is obtained from the Atkinson and Holliday (1977) relationship (Table 4-1).

4.2. SOUTH PACIFIC AND SOUTH INDIAN OCEAN TROPIAL CYCLONES

Tropical cyclone activity in 1991 (Table 4-2) was below the climatological mean of 27 storms, and the second lowest seasonal total since 1981 (Table 4-3). The below-average number of cyclones was a reflection of light activity in the South Pacific. Although the number of storms in the rest of the Southern Hemisphere was near normal, only one tropical

TABLE 4-1 MAXIMUM SUSTAINED SURFACE WINDS AND EQUIVALENT MINIMUM SEA-LEVEL PRESSURE (ATKINSON AND HOLLIDAY, 1977)

MAXIMUM SUSTAINED SURFACE WIND (KT)	MINIMUM SEA-LEVEL PRESSURE (MB)
30	1000
35	997
40	994
45	991
50	987
55	984
60	980
65	976
70	972
75	967
80	963
85	958
90	954
95	948
100	943
105	938
110	933
115	927
120	922
125	916
130	910
135	906
140	898
145	892
150	885
155	879
160	872
165	865
170	858
175	851
180	844

cyclone, Sina (03P) occurred east of 165°E (Table 4-4). Tropical cyclone activity was spread evenly throughout the season, which began in late September and ended in early June. Peak activity occurred on 27 February, when four cyclones were in warning status at the same time.

Twenty-six initial tropical cyclone formation alerts were issued in 1991, and except for Tropical Cyclone 10S, each preceded the first warning. The JTWC was in warning status a total of 105 days, which includes 20 days when the JTWC issued warnings on two or more Southern Hemisphere cyclones. Tropical Cyclone 08S (Bella), which lasted for 15 days, was the only system to reach super typhoon intensity.

TABLE 4-2 **SOUTH PACIFIC AND SOUTH INDIAN OCEAN 1990 SIGNIFICANT TROPICAL CYCLONES (1 July 1990 - 30 June 1991)**

TROPICAL CYCLONE	PERIOD OF WARNING	NUMBER WARNINGS ISSUED	MAXIMUM SURFACE WINDS-KT (M/SEC)	ESTIMATED MSLP (MB)
01S ----	21 Sep - 25 Sep	10	30(15)	1000
02S ----	18 Oct - 20 Oct	5	30(15)	1000
03P Sina**	24 Nov - 29 Nov	8	125(64)	916
04S ----	03 Dec - 04 Dec	3	55(28)	984
05S Laurence	15 Dec - 16 Dec	4	35(18)	997
06P Joy	18 Dec - 26 Dec	16	90(46)	954
07S Alison	12 Jan - 18 Jan	18	65(33)	976
08S Bella	20 Jan - 04 Feb	31	130(67)	910
09S Chris	16 Feb - 21 Feb	11	50(26)	987
09S Chris*	22 Feb - 23 Feb	3	30(15)	1000
10S Cynthia	16 Feb - 17 Feb	3	50(26)	987
11S Daphne	22 Feb - 27 Feb	12	60(31)	980
12S Debra	24 Feb - 04 Mar	17	90(46)	954
13P Kelvin	25 Feb - 06 Mar	19	55(28)	984
14S Elma	27 Feb - 03 Mar	10	60(31)	980
15P ----	06 Mar - 07 Mar	2	30(15)	1000
16P ----	18 Mar - 20 Mar	5	30(15)	1000
17S Fatima	22 Mar - 01 Apr	21	90(46)	954
18S Errol	25 Mar - 29 Mar	15	110(57)	933
18S Errol*	30 Mar - 31 Mar	4	35(18)	997
19S Marian	10 Apr - 19 Apr	18	95(49)	948
20S Fifi	16 Apr - 20 Apr	9	55(28)	984
21P Lisa	07 May - 12 May	11	70(36)	972
22S Gritelle	08 Jun - 12 Jun	9	40(21)	994
	Total:	**264**		

* Regenerated

** An Additional 3 Warnings Issued by NWOC

NOTE: Names of Southern Hemisphere Tropical Cyclones are given by the Regional Warning Centers (Nadi, Brisbane, Darwin, Perth, Reunion and Mauritius) and are appended to JTWC Warnings, when available.

TABLE 4-3 **MONTHLY DISTRIBUTION OF SOUTH PACIFIC AND SOUTH INDIAN OCEAN TROPICAL CYCLONES**

YEAR	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	TOTAL
(1959-1978) AVERAGE*	-	-	-	0.4	1.5	3.6	6.1	5.8	4.7	2.1	0.5	-	24.7
1981	0	0	0	1	3	2	6	5	3	3	1	0	24
1982	1	0	0	1	1	3	9	4	2	3	1	0	25
1983	1	0	0	1	1	3	5	6	3	5	0	0	25
1984	1	0	0	1	2	5	5	10	4	2	0	0	30
1985	0	0	0	0	1	7	9	9	6	3	0	0	35
1986	0	0	1	0	1	1	9	9	6	4	2	0	33
1987	0	1	0	0	1	3	6	8	3	4	1	1	28
1988	0	0	0	0	2	3	5	5	3	1	2	0	21
1989	0	0	0	0	2	1	5	8	6	4	2	0	28
1990	2	0	1	1	2	2	4	4	10	2	1	0	29
1991	0	0	1	1	1	3	2	5	5	2	1	1	22
TOTAL CASES:	5	1	3	6	17	33	65	73	51	33	11	2	300
(1981-1991) AVERAGE:	0.5	0.1	0.3	0.5	1.5	3.0	5.9	6.6	4.6	3.0	1.0	0.1	27.3

* (Gray, 1979)

TABLE 4-4 **ANNUAL VARIATION OF SOUTHERN HEMISPHERE TROPICAL CYCLONES BY OCEAN BASIN**

YEAR	SOUTH INDIAN (WEST OF 105°E)	AUSTRALIAN (105°E - 165°E)	SOUTH PACIFIC (EAST OF 165°E)	TOTAL
(1959-1978) AVERAGE*	8.4	10.3	5.9	24.7
1981	13	8	3	24
1982	12	11	2	25
1983	7	6	12	25
1984	14	14	2	30
1985	14	15	6	35
1986	14	16	3	33
1987	9	8	11	28
1988	14	2	5	21
1989	12	9	7	28
1990	18	8	3	29
1991	11	10	1	22
TOTAL CASES:	138	107	55	300
(1981-1991) AVERAGE:	12.5	9.7	5.0	27.3

* (Gray, 1979)

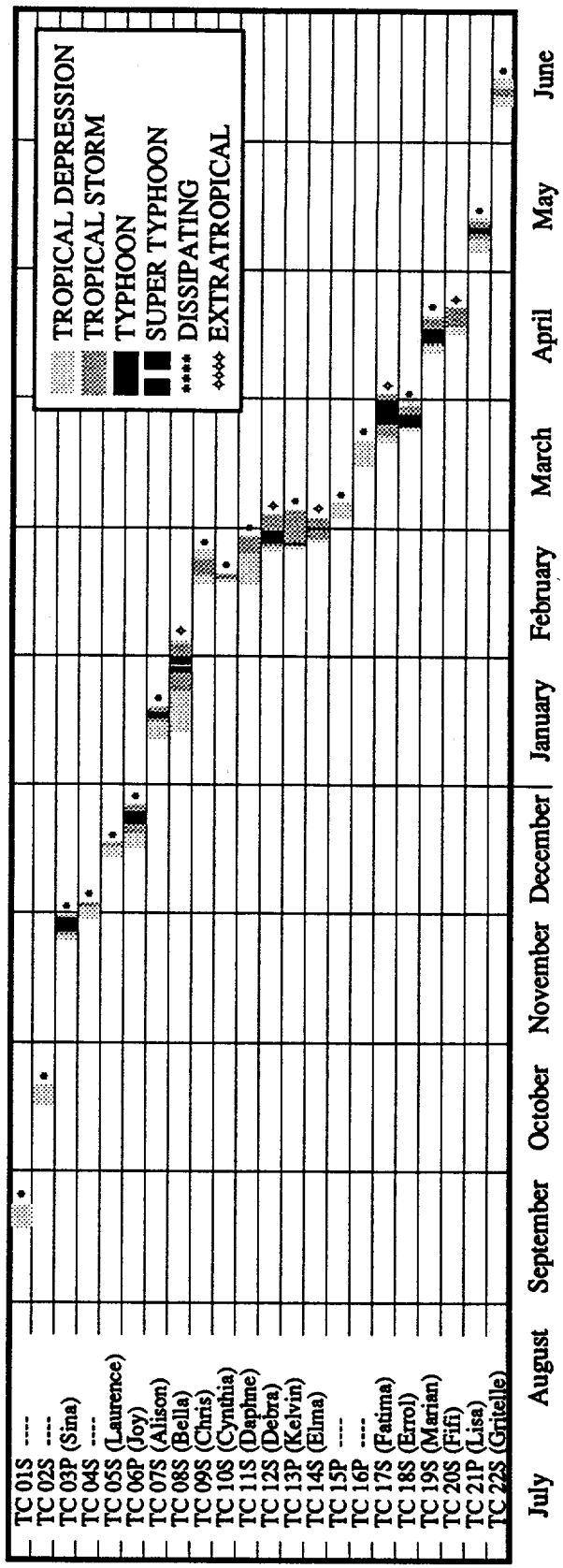
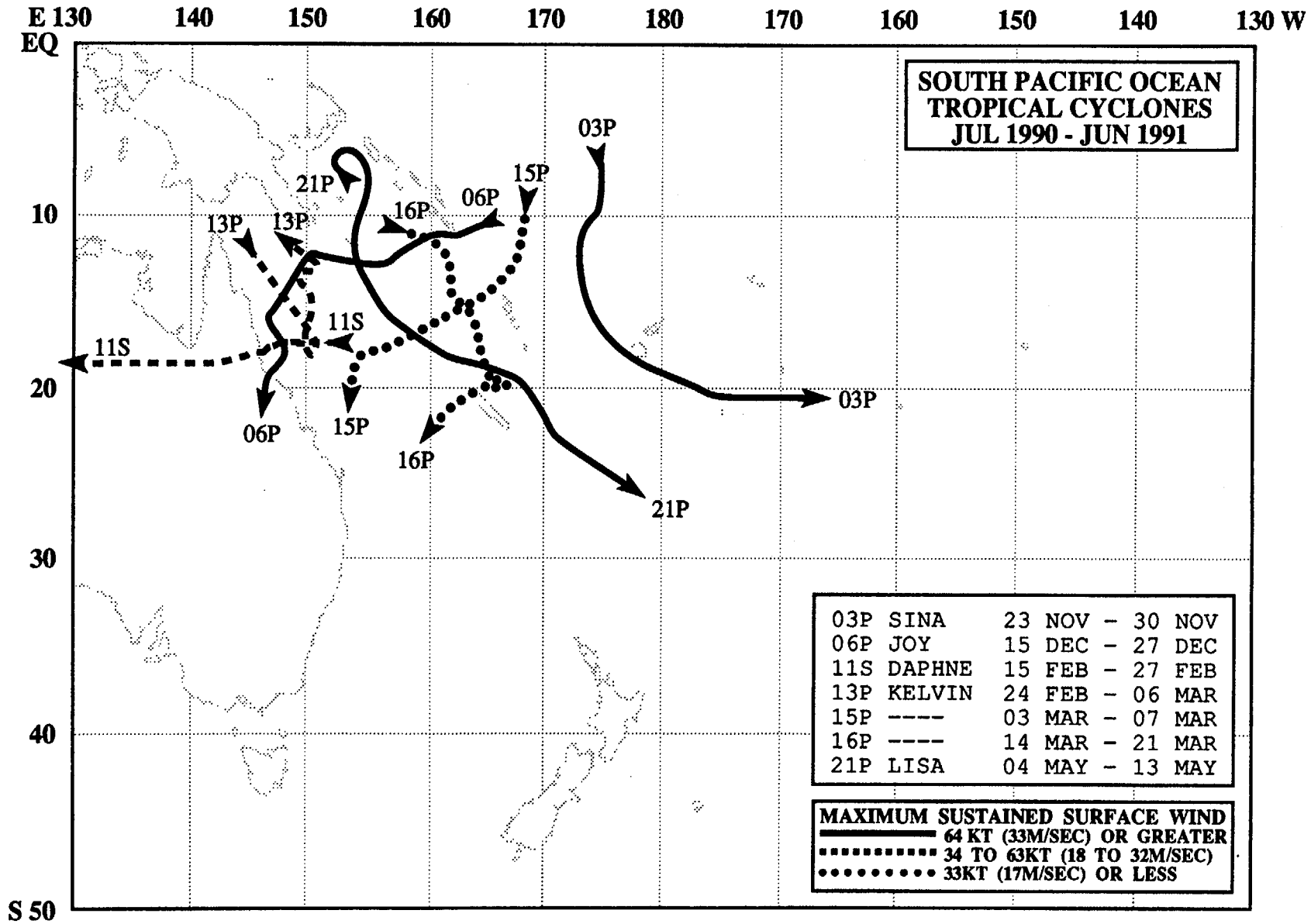
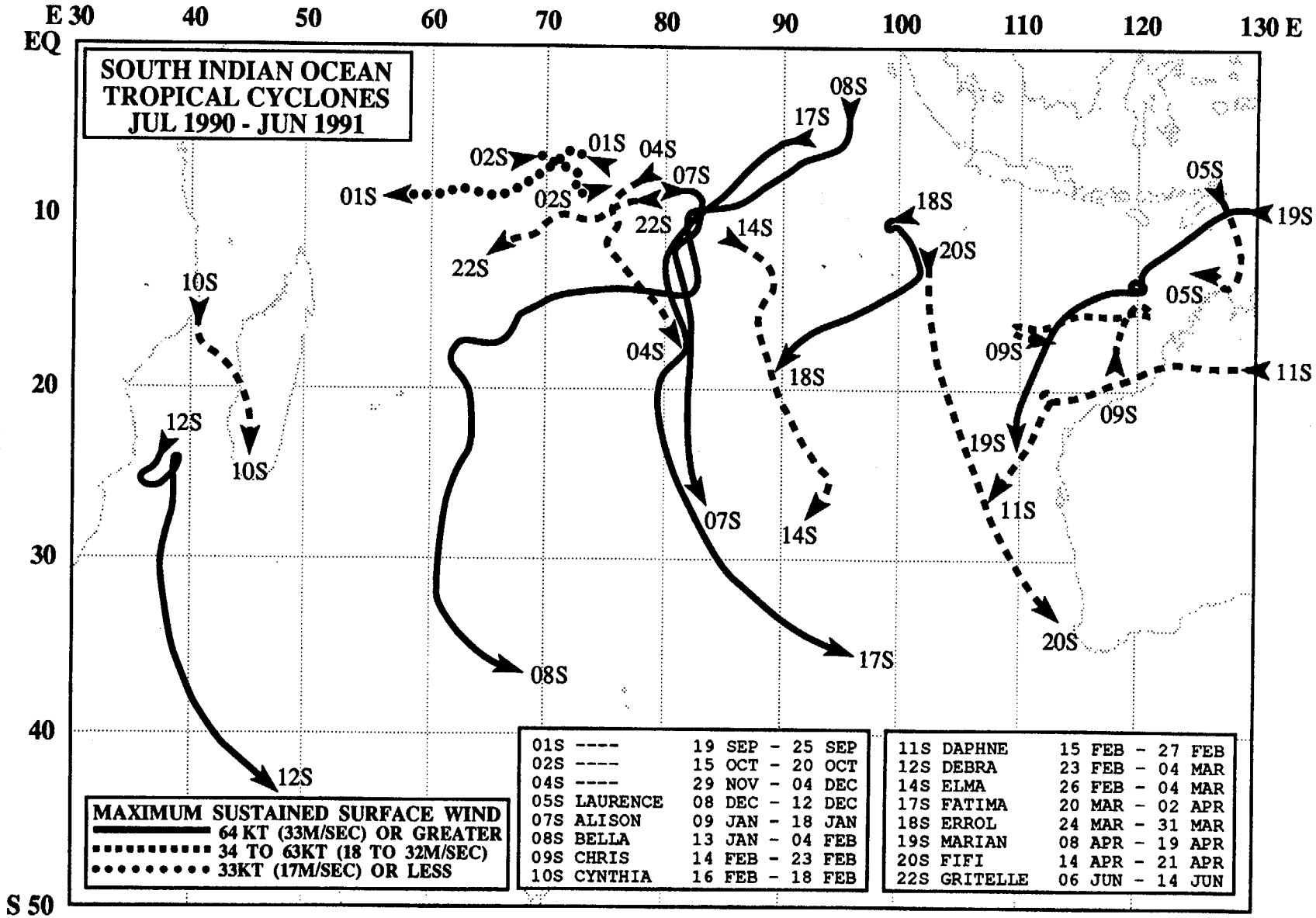


Figure 4-1. Chronology of South Pacific and South Indian Ocean tropical cyclones for 1990.


E 130
140
150
160
170
180
170
160
150
140
130 W
EQ
10
20
30
40
S 50
SOUTH PACIFIC OCEAN
TROPICAL CYCLONES
JUL 1990 - JUN 1991
03P
15P
06P
16P
21P
13P
13P
11S
11S
03P
06P
15P
16P
21P
03P SINA 23 NOV - 30 NOV
06P JOY 15 DEC - 27 DEC
11S DAPHNE 15 FEB - 27 FEB
13P KELVIN 24 FEB - 06 MAR
15P ---- 03 MAR - 07 MAR
16P ---- 14 MAR - 21 MAR
21P LISA 04 MAY - 13 MAY
MAXIMUM SUSTAINED SURFACE WIND
64 KT (33M/SEC) OR GREATER
34 TO 63KT (18 TO 32M/SEC)
33KT (17M/SEC) OR LESS


SOUTH INDIAN OCEAN
TROPICAL CYCLONES
JUL 1990 - JUN 1991
E 30
40
50
60
70
80
90
100
110
120
130 E
EQ
10
20
30
40
S 50
MAXIMUM SUSTAINED SURFACE WIND
64 KT (33M/SEC) OR GREATER
34 TO 63KT (18 TO 32M/SEC)
33KT (17M/SEC) OR LESS
01S ---- 19 SEP - 25 SEP
02S ---- 15 OCT - 20 OCT
04S ---- 29 NOV - 04 DEC
05S LAURENCE 08 DEC - 12 DEC
07S ALISON 09 JAN - 18 JAN
08S BELLA 13 JAN - 04 FEB
09S CHRIS 14 FEB - 23 FEB
10S CYNTHIA 16 FEB - 18 FEB
11S DAPHNE 15 FEB - 27 FEB
12S DEBRA 23 FEB - 04 MAR
14S ELMA 26 FEB - 04 MAR
17S FATIMA 20 MAR - 02 APR
18S ERROL 24 MAR - 31 MAR
19S MARIAN 08 APR - 19 APR
20S FIFI 14 APR - 21 APR
22S GRITELLE 06 JUN - 14 JUN